Tektronix®

AWG-HD
HDMI Fixture

Programmer Manual

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- Worldwide, visit www.tek.com to find contacts in your area.

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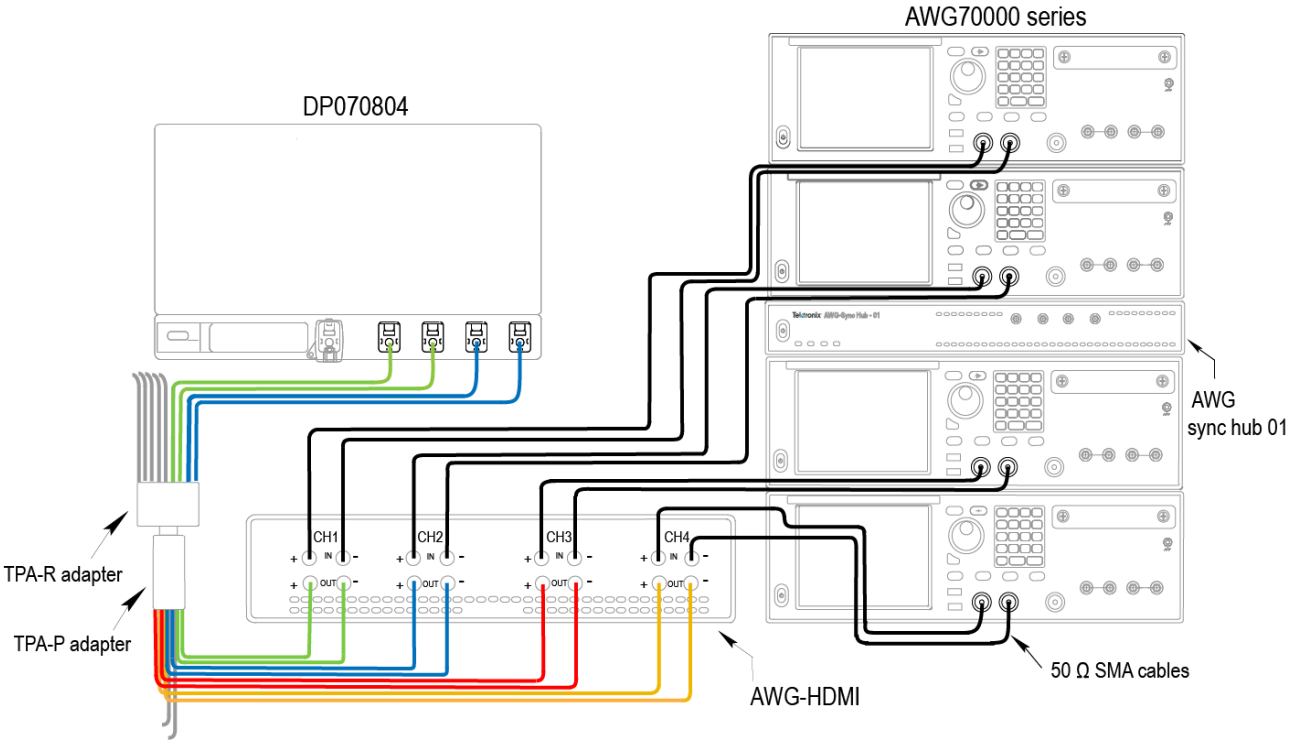
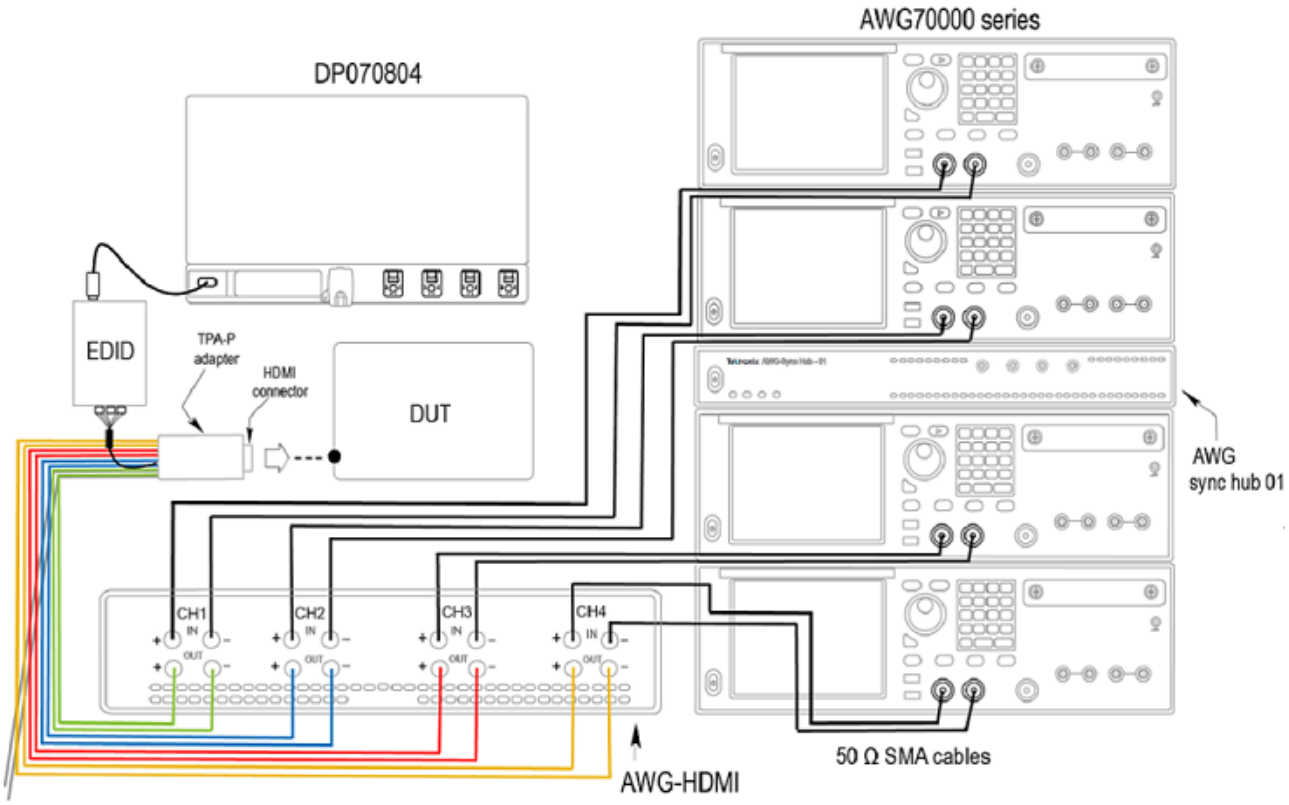
Syntax and Commands

Preface

This manual provides the SCPI commands needed to remotely control the AWG-HD instrument. The AWG-HD instrument is typically installed in a system that consists of multiple Tektronix Arbitrary Waveform Generators (AWG70000 Series), an oscilloscope, and several adapters. Please visit www.tek.com for more information about this product.




AWG70000 series
DP070804
EDID
TPA-P adapter
HDMI connector
DUT
AWG sync hub 01
CH1
CH2
CH3
CH4
IN
OUT
AWG-HDMI
50 Ω SMA cables

Syntax and Commands

Command Syntax

You can program the AWG-HD using commands and queries. The commands include all IEEE 488.2 Common Commands. Commands and queries are organized in the following subsections:

- Backus-Naur Form Definition
- IEEE 488.2 Common Commands
- Constructed Mnemonics

Backus-Naur Form Definition

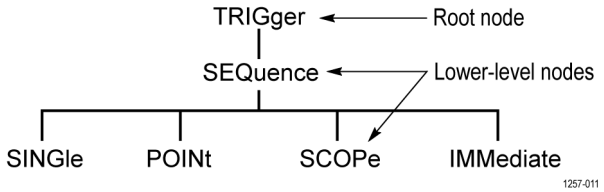
The definition for some commands and queries uses the Backus-Naur Form (BNF) notation. The following table defines standard BNF symbols:

Symbol	Meaning
< >	Defined element
::=	Is defined as
|	Exclusive OR
{ }	Group; one element is required
[ ]	Optional; can be omitted
. . .	Previous element(s) may be repeated
( )	Comment

SCPI Commands and Queries

SCPI is a standard created by a consortium that provides guidelines for remote programming of instruments. These guidelines provide a consistent programming environment for instrument control and data transfer. This environment uses defined programming messages, instrument responses, and data format across all SCPI instruments, regardless of manufacturer. The analyzer uses a command language based on the SCPI standard.

The SCPI language is based on a hierarchical or tree structure, which represents a subsystem, as shown in the following figure. The top level of the tree is the root node; it is followed by one or more lower-level nodes:



You can create commands and queries from these subsystem hierarchy trees. Commands specify actions for the instrument to perform. Queries return measurement data and information about parameter settings.

Creating Commands

SCPI commands are created by stringing together the nodes of a subsystem hierarchy and separating each node by a colon.

In the above figure, TRIGger is the root node and SEQuence, IMMediate, POINt, SINGle, SCOPe and SOURce are all lower-level nodes. To create a SCPI command, start with the root node TRIGger and move down the tree structure adding nodes until you reach the end of a branch. Most commands and some queries have parameters and each parameter must include a value. If you specify a parameter value that is out of range, the parameter will be set to a default value. Command descriptions list the values that are valid for all parameters.

For example, TRIGger:SEQuence:SCOPe ALL is a valid SCPI command created from the hierarchy tree, using ALL as an argument.

Creating Queries

To create a query, start at the root node of a tree structure and then move down to the end of a branch, nd add a question mark. For example, `TRIGger:SEQuence:SCOPe?` is a valid SCPI query, using the hierarchy tree in the figure.

Query Responses

The query causes the analyzer to return information about its status or settings. When a query is sent to the analyzer, only the values are returned. For example, `SENSe1:AVERage:COUNt?` may return 400 as the averaging factor value for channel 1.

A few queries also initiate an operation action before returning information. For example, the `*CAL?` query runs a calibration.

Parameter Types

Every parameter in the command and query descriptions is of a specified type. Parameters are enclosed in brackets, such as <value>. The parameter type is listed after the parameter and is enclosed in parentheses, for example, (boolean). Some parameter types are defined specifically for the VNA Series command set and some are defined by ANSI/IEEE 488.2-1987 as shown on the following table:

Parameter type	Description	Example
arbitrary block [1]	Specified length of arbitrary data	#512234xxxxx . . . where 5 indicates that the following 5 digits (12234) specify length of data in bytes; xxxxx ... indicates data
boolean	Boolean numbers or values	ON or 1; OFF or 0
binary	Binary numbers	#B0110

Parameter type	Description	Example
octal	Octal numbers	#Q57, #Q3
hexadecimal [2]	Hexadecimal numbers (0-9, A, B, C, D, E, F)	#HAA, #H1
NR1 [2] numeric	Integers	0, 1, 15, -1
NR2 [2] [3] numeric	Decimal numbers	1.2, 3.141516, -6.5
NR3 [2] numeric	Floating point numbers	3.1415E-9, -16.1E5
NRf [2] numeric	Flexible decimal number may be type NR1, NR2 or NR3	See NR1, NR2, and NR3 examples
string [4]	Alphanumeric characters (must be within quotation marks)	"Testing 1, 2, 3"

1 Defined in ANSI/IEEE 488.2 as Definite Length Arbitrary Block Response Data.

2 An ANSI/IEEE 488.2-1992-defined parameter type.

3 Some commands and queries will accept an octal or hexadecimal value even though the parameter type is defined as NR1.

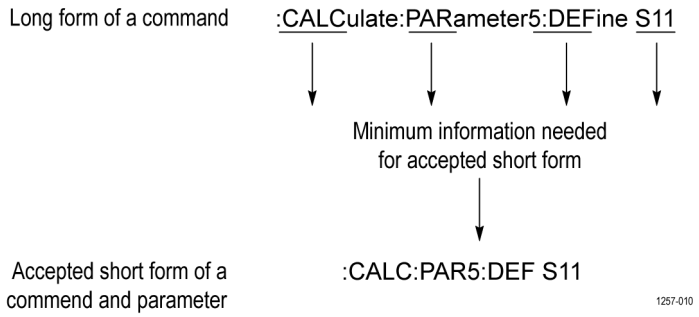
4 Defined in ANSI/IEEE 488.2 as String Response Data.

Special Characters

The Line Feed (LF) character (ASCII 10), and all characters in the range of ASCII 127-255 are defined as special characters. These characters are used in arbitrary block arguments only; using these characters in other parts of any command yields unpredictable results.

Abbreviating Commands, Queries, and Parameters

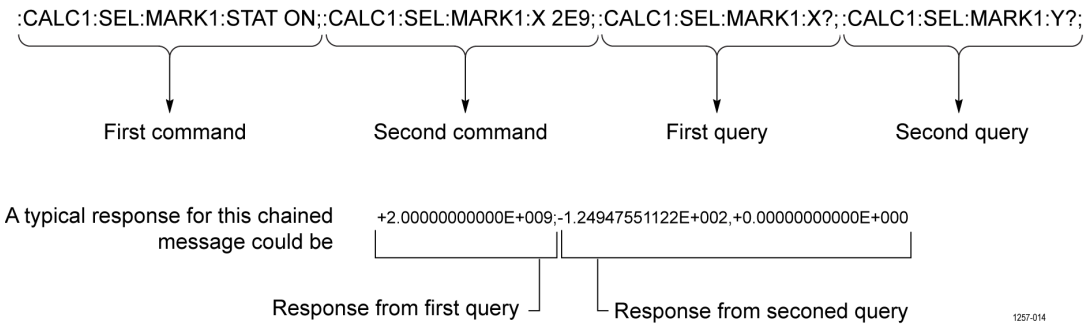
You can abbreviate most SCPI commands, queries, and parameters to an accepted short form. This manual shows these short forms as a combination of upper and lower case letters. The upper case letters indicate the accepted short form of a command. You can create a short form by using only the upper case letters, as shown in the next figure. The accepted short form and the long form are equivalent and request the same action of the instrument:



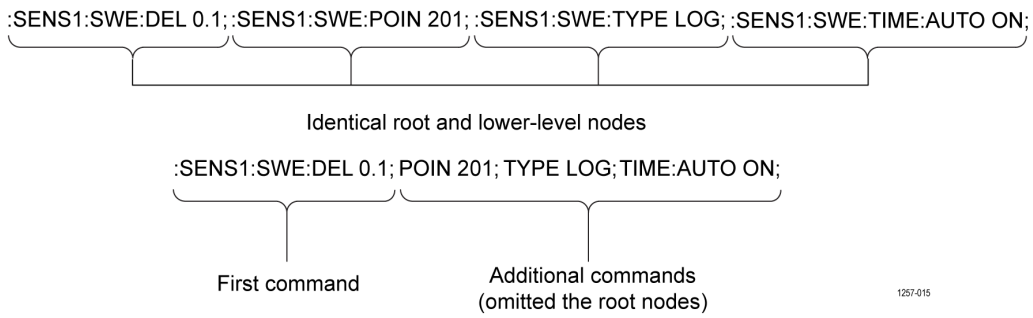
NOTE. *The numeric suffix of a command or query may be included in either the long form or short form; the analyzer will default to "1" if no suffix is used. In the above figure, the "5" in "PARameter5" indicates that the command is targeting trace 5 for channel 1.*

Chaining Commands and Queries

You can chain several commands or queries together into a single message. To create a chained message, first create a command or query, add a semicolon (;), and then add more commands or queries and semicolons until the message is complete. Commands following a semicolon are a root node. You must precede them with a colon ":". The following figure illustrates a chained message consisting of several commands and queries. The single chained message must end in a command or query, not a semicolon. Responses to any queries in your message are separated by semicolons.



If a command or query have the same root and lower-level nodes as the previous command or query, you can omit these nodes. In the following figure, the second, third, and fourth commands have the same root node (SENSe1:SWEep) as the first command, so these nodes can be omitted.



Unit and SI Prefix

If the decimal numeric argument refers to amplitude, frequency, or time, you can express it using SI units instead of using the scaled explicit point input value format <NR3>. (SI units are units that conform to the Systeme International d'Unites standard.) For example, you can use the input format 200 mV or 1.0 MHz instead of 200.0E-3 or 1.0E+6, respectively, to specify voltage or frequency. The next table lists the available units:

Symbol	Meaning
dB	Decibel (relative amplitude)
dBm	Decibel (absolute amplitude)
DEG	Degree (phase)
Hz	Hertz (frequency)

Symbol	Meaning
PCT	Percent (%)
s	Second (time)
V	Volt

The available SI prefixes are shown in the following table.

SI prefix	Z	A	F	P	N	U	M	K	MA[1]	G	T	PE	EX
Corresponding power	10^{-21}	10^{-18}	10^{-15}	10^{-12}	10^{-9}	10^{-6}	10^{-3}	10^{+3}	10^{+6}	10^{+9}	10^{+12}	10^{+15}	10^{+18}

1 When the unit is "Hz", "M" may be used instead of "MA" so that the frequency can be represented by "MHz".

You can omit a unit in a command, but you must include the unit when using a SI prefix. For example, a frequency of 15 MHz can be described:

15.0e6, 1.5e7 Hz, 15000000, 15000000 Hz, 15 MHz, etc.

("15M" is not allowed.)

Note that you can use either lower or upper case units and prefixes. The following examples have the same result, respectively.

170 mHz, 170 Mhz, 170 MHz, etc.

250 mv, 250 mV, 250 MV, etc.

General Rules

Here are three general rules for using SCPI commands, queries, and parameters:

- You can use single (‘ ’) or double (“ ”) quotation marks for quoted strings, but you cannot use both types of quotation marks for the same string.

  correct "This string uses quotation marks correctly."

  correct ‘This string also uses quotation marks correctly.'

  incorrect "This string does not use quotation marks correctly.'

- You can use upper case, lower case, or a mixture of both cases for all commands, queries, and parameters.

  ```
  SYSTEM:BEEPER:WARNING:STATE ON
  ```

  is the same as

  ```
  system:beeper:warning:state on
  ```

  and

  ```
  SYSTem:BEEPer:WARNing:STATe ON
  ```

NOTE. *Literal strings (quoted) are case sensitive, such as file names.*

- No embedded spaces are allowed between or within nodes:

  correct `SYSTem:BEEPer:WARNing:STATe ON`

  incorrect `SYSTem:  BEEPer:  WARNing:  STATe ON`

IEEE 488.2 Common commands

Description

ANSI/IEEE Standard 488.2 defines the codes, formats, protocols, and usage of common commands and queries used on the interface between the controller and the instruments. The AWG-HD complies with this standard.

Command and Query Structure

The syntax for an IEEE 488.2 common command is an asterisk (*) followed by a command and, optionally, a space and parameter value. The syntax for an IEEE 488.2 common query is an asterisk (*) followed by a query and a question mark. All of the common commands and queries are listed in the last part of the *Syntax and Commands* section. These are examples of IEEE common commands:

- *ESE 16
- *CLS

These are examples of common queries:

- *ESR
- *IDN

Command Descriptions

*CAL

Calibrate or query the calibration of the Colby units.

Group IEEE command group

Syntax
```
*CAL <arg>
*CAL? <arg>
```

Arguments <arg> is the specified channel.

Returns
<boolean>
1 means the calibration failed.
0 means the calibration passed.

Examples *CAL CH:1 runs channel 1 through the calibration process.

*CAL? CH:2 may return 0 or 1, indicating the calibration passed or failed for channel 2.

DEL

Set or query the delay of the specified channel in the AWG-HD.

Group Vertical command group

Syntax
```
DEL <arg1> <arg2>
DEL? <arg2>
```

Arguments <arg1> is the delay (in ps) of the specified channel.

<arg2> is the specified channel.

Returns <NRf>

Examples DEL 100 CH:1 sets the delay of channel 1 to 100 ps, which could take up to 5 seconds for adjustment to finish.

DEL? CH:1 may return 100.000, which indicates the channel 1 delay is 100 ps.

STEP (No Query Form)

Step the delay for the specified channel in the AWG-HD.

Group Vertical command group

Syntax STEP <arg1> <arg2>

Arguments <arg1> is the delay (in ps) of the specified channel.

<arg2> is the channel number.

Examples STEP 100 CH:1 sets the delay of channel 1 to be stepped 100 ps.

STEP 123.5 CH:2 sets the delay of channel 2 to be stepped 123.5 ps.

*IDN? (Query Only)

Query the AWG-HD identification information.

Group IEEE common commands

Syntax *IDN? <arg>

Arguments <arg>

Returns <string>

Value	Description
TEKTRONIX	Indicates Tektronix is the manufacturer.
AWG-HD	Indicates the model number.
PQ0001	Indicates the serial number.
FV:2.0	Indicates the firmware version.

Examples `*IDN?` may return `TEKTRONIX,AWG-HD,PQ0001,FV:2.0`, where TEKTRONIX is the manufacturer name, AWG-HD is the model number, PQ0001 is the serial number, and FV:2.0 is the firmware version.

ERROR? (Query Only)

Query the AWG-HD for errors, returning the most recent errors, one at a time, from most recent to oldest.

Group Status and Error command group

Syntax `ERROR?`

Returns `<string>`

Examples `ERROR?` may return `0`, which indicates that there are no errors registered.

`ERROR?` may return `-120 Numeric Data:  Error parsing voltage`.

REBOOT (No Query Form)

Reboot the AWG-HD.

Group Miscellaneous command group

Syntax `REBOOT`

Arguments None

Examples `REBOOT` reboots the device, which takes approximately 15 s to fully reboot.

MAC? (Query Only)

Query the AWG-HD MAC address.

Group Miscellaneous command group

Syntax `MAC?`

Returns `<string>`

Examples `MAC?` may return `b8:17:eb:b7:30:bc`, which is the AWG-HD MAC address.

SERVICE? (Query Only)

Query the usage numbers for each channels' delay commands.

Group Miscellaneous command group

Syntax `SERVICE?`

Returns `<string>`

Examples `SERVICE?` may return `CH1:1320 CH2:1539 CH3:1556 CH4:1234`, which indicates that the usage numbers for channels 1 to 4 are: 1320 for channel 1, 1539 for channel 2, etc.

IP? (Query Only)

Query the AWG-HD IP address.

Conditions Must be used if the only communication information known about the AWG-HD is its hostname.

Group Miscellaneous command group

Syntax `IP?`

Returns <string>

Examples `IP?` may return `134.62.8.217`, which is the AWG-HD IP address.

ZERO

Set or query the zero delay point of the AWG-HD.

Group Vertical command group

Syntax

```
ZERO <arg1> <arg2>
ZERO
ZERO?
```

Arguments <arg1> is the zero skew setpoint (in ps) of the AWG-HD.

<arg2> is the channel number.

ZERO sets all four channels to their stored Zero point.

Returns <string>

Examples ZERO 312.5 CH:1 sets the zero skew setpoint to be stored at 312.5 ps for channel 1. Resulting calls of ZERO set the delay point at 312.5 ps for channel 1.

ZERO? may return CH1: 312.5 CH2: 312. CH3: 312.5 CH4: 312.5, which means the zero skew setpoint of channel 1 is currently stored at 312.5 ps, channel 2 at 312 ps, etc.

OUTPUT

Set or query the state of the RF signal output.

Group Vertical command group

Syntax

```
OUTPUT { ENABLE | DISABLE }
OUTPUT?
```

Arguments ENABLE enables the RF signal output.

DISABLE disables the RF signal output.

Returns ENABLE means the RF signal output is turned on.

DISABLE means the RF signal output is turned off.

Examples

NOTE. *There may be a warmup needed with the output before the bias voltage of the device can settle. This usually takes about 30 seconds.*

`OUTPUT ENABLE` enables the RF signal output.

`OUTPUT DISABLE` disables the RF signal output.

`OUTPUT?` may return `ENABLE`, which indicates that the RF signal output is turned on.

`OUTPUT?` may return `DISABLE`, which indicates that the RF signal output is turned off.

VOLT

Set or query the common mode voltage output.

Conditions The device connected must be 50 Ω terminated to 3.3 V.

Group Vertical command group

Syntax

```
VOLT <arg1> [<arg2>][<arg3>]
VOLT?
```

Arguments

`<arg1>` is the common mode voltage for both positive and negative legs for the specified channel.

`<arg2>` is the channel number.

`<arg3>` is the positive (P) or negative leg (N).

Returns

`<string>`

`<NRf>`

Examples

`VOLT 3.3 CH:1` sets both positive and negative common mode voltage to 3.3 V for channel 1.
`VOLT 3.31 CH:2P` sets the positive common mode voltage to 3.31 V for channel 2.
`VOLT 3.3` sets both positive and negative common mode voltage to 3.3 V for all channels.
`VOLT?` may return 3.3, which means both positive and negative common voltage is 3.3 V for all channels.

VOLT? may return CH1P: 1.2, CH1N: 1, CH2P: 2, CH2N: 2, CH3P: 3, CH3N: 3, CH4P: 0, CH4N: 0, where the positive common voltage for channel 1 is 1.2 V and 1 V for the negative leg. The other return values show the common voltages for the noted channels and legs.

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